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ECONOMIC REPORT ON HAWAII'S COMMERCIAL BOTTOM FISHERY, 1986
(Economic Module, Bottom Fish FMP)

Samuel G. Pooley and Kurt E. Kawamoto
Southwest Fisheries Center Honolulu Laboratory
National Marine Fisheries Service, NOAA
Honolulu, Hawaii 96822-2396

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INTRODUCTION

This report is the first economic "module" under the Bottom Fish and Seamount Groundfish Fishery Management Plan (FMP) for the western Pacific. The FMP prepared by the Western Pacific Regional Fishery Management Council (Council) (1986) calls for an annual report comprised of a series of independent reports (modules) on aspects of the fishery.

This report describes the recent history of Hawaii's bottom fish fishery, provides preliminary estimates of revenue in Hawaii's bottom fish market for 1986, analyzes fleet dynamics, provides estimates of revenue per vessel for 1986, and proposes a number of research items for the forthcoming year. The report is limited to information on the Hawaii fishery. Information on the bottom fish fisheries of American Samoa, Guam, and the Northern Mariana Islands is contained in a separate module. Information on the biological status of the bottom fish stocks in Hawaii is contained in another module (Ralston and Kawamoto 1987). Ralston and Kawamoto (1987) is also the source of information on species identification.

A project with substantial bearing on this report is the limited entry proposal being prepared by Philip A. Meyer on behalf of the Council (Meyer 1987). Meyer's various reports comprise a pragmatic picture of the bottom fish fishery in the Northwestern Hawaiian Islands (NWHI), and no attempt will be made here to replicate that work.

RECENT HISTORY

The Hawaii deep-sea handline fishery for snappers, groupers, and jacks has grown dramatically over the past 5 yr, with a number of bottom fish species highly valued in restaurant markets. The fishery expanded into the NWHI in the late 1970's, but over half the landings are still from the main Hawaiian Islands (MHI), and fresh bottom fish imported from Pacific island countries is now competing effectively in the Hawaii market.

The number of "active" vessels in the NWHI bottom fishery has grown from 19 in 1984 to 24 in 1986. ("Active vessels" are those vessels taking more than one fishing trip per year.) Although there has been an annual attrition of three vessels per year, new entrants have kept the fleet growing. Through the past 3 yr, a core of 12 vessels has consistently participated in the NWHI fishery.

As the fishing fleet expanded the volume of catch of the six major targeted bottom fish species in the NWHI rose annually, from approximately 500,000 lb[1] (227,000 kg) in 1984 to over 700,000 lb (317,000 kg) in 1986 (as monitored by the Council and the Southwest Fisheries Center Honolulu Laboratory). During 1984-85, most of the vessels were fishing islands that

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[1]Landings and prices are reported in pounds, which is the industry standard in Hawaii (1 kg = 2.2 lb and 1 metric ton = 2,205 lb).

previously were either unfished or fished very little. By 1986, there were few, if any, unexplored banks, and the economic effect of fishing pressure on the availability of snappers and groupers was clear. Individual fishermen reported exploratory fishing trips in excess of 1,000 nmi in an attempt to find more productive areas, and a number of the core bottom fishing vessels were expected to leave the fishery entirely by the end of 1987.

The increased fishing pressure in 1985 resulted in a decline in the annual catch of opakapaka, the most desired species at that time. Although the decline was not drastic, the fishermen reported that large schools of opakapaka were increasingly hard to locate. During the latter half of 1985, vessels began to focus on onaga, a highly valued but relatively unfished species. The onaga is a deeper dwelling species and commands a price comparable to opakapaka. However, by the end of 1986, onaga catch rates were also declining, and because of shorter shelf life, vessels could not range as far up the NWHI chain and return with a salable product.

HAWAII MARKET

The Hawaii bottom fish market in 1986 was an estimated $5.3 million, based on wholesale market purchase values (Table 1). Sales from the NWHI bottom fish comprised 37% of the market ($1.9 million), and from the MHI, 50% ($2.7 million). Imports from Pacific island areas comprised 13% of total sales ($700,000).

The average price for bottom fish from the NWHI in 1986 was $2.23/lb essentially the same as in 1985 ($2.22/lb) and 1984 ($2.35/lb) (Table 2). Average price for MHI bottom fish ($3.24/lb) was 45% higher than that for the NWHI landings in 1986 while the average imported price ($2.38/lb) was in between these prices (Table 1). These prices do not account for differences in species composition or seasonal distribution.

Preliminary market information for the Hawaii bottom fish fishery in 1986 is presented in Tables 1 and 2 and Figures 1 and 2, and changes in the NWHI market from 1984 to 1986 are depicted in Figures 3 and 4. The data come from market monitoring implemented by the Council in 1984 and taken up by the Honolulu Laboratory in mid-1986. These data are preliminary estimates of revenue because a consistent method for expanding market sampling to the entire market has not yet been developed. Figures in other reports with data on the number of pounds sold differ because of the market-based extrapolation used for these revenue data.

The value of the Hawaii bottom fish fishery is subject to the vicissitudes of the fresh fish market. A consistent complaint by NWHI bottom fish fishermen has been the relatively lower price received for their catch. The major factor affecting these prices, which are substantially higher than most mainland fresh fish prices because of the strong Hawaii market, is the total quantity of bottom fish landed during the week. For vessels taking longer trips into the NWHI, the problems of short-term oversupply and diminished quality can be substantial.

Fishing vessel operators try to control the length and timing of their fishing trips on the expectation that the market will not be depressed by recent landings or by out-of-season demand. Based on an analysis of price response in the Hawaii bottom fish market, the average Hawaii bottom fish prices in 1984 varied only 23% as much as quantity on a weekly basis and 42% on a monthly basis (Pooley 1987). Quality premiums were observed with the higher price for MHI fish, which received up to a 50% price bonus. Price and quantity interrelationships between species groups were observed but were relatively small between the higher valued species, such as opakapaka and onaga.

A parallel statistical investigation was conducted on 1985 Hawaii market data, and the results were essentially the same as for 1984. The weekly price fluctuations are in Figure 5, and the price-quantity relationship is in Figure 6. The coefficient of variation (CV) for market price, defined as the ratio of the standard deviation to the mean, was 30.4% and, for market quantity, was 43.3%. For NWHI bottom fish, the price variation was 39.2%, and the quantity variation was 57.7%. For MHI bottom fish, the price variation was 29.4%, and the quantity variation was 60.0%.

Forty-four percent of the total price variation can be explained by a simple linear regression of weekly bottom fish prices on quantity sold in the Honolulu market from the MHI and NWHI fisheries and a dummy variable representing seasonal factors:

Price = $3.99 + 0.69 CD - 5.2E-5 QNWHI - 3.2E-5 QMHI - 4.6E-5 QOTH

t-statistic (+ 2.50* - 4.05* - 2.61* - 1.56);

where

Price is price per pound of bottom fish (weekly average),
CD is the consumer dummy variable valued at 1 during peak seasonal buying periods,
QNWHI is the quantity sold from the NWHI that week,
QMHI is the quantity sold from the MHI that week,
QOTH is the quantity sold from other areas that week,
$R^2 = 0.42$,
N = 52 weeks in 1985,
Durbin-Watson = 1.41 (data not corrected for serial correlation), and
* = significant at the 95% confidence level.

Market price and quantity landed from the NWHI were highly correlated ($r = -0.58$), but market price was less closely correlated with MHI landings ($r = -0.30$).

Data for 1986 were not obtained in time to undertake a similar analysis. However, it is clear from the summary data on prices (Table 3) that the price differential between NWHI and MHI bottom fish continues. The Hawaii market in 1986 also obtained a considerable supply of fresh and frozen bottom fish from other Pacific island areas. Their prices were in between MHI and NWHI prices, on average. The 1987 economic module should

be able to update the 1986 and 1987 price response analysis and incorporate consideration of the Pacific island sales.

FLEET DYNAMICS

There were 45 NWHI bottom fish vessels under permit at the end of 1986 (Table 4). The NWHI bottom fishing fleet is composed of a number of types of vessels, many of which have been displaced from other fisheries. These include mainland U.S. shrimp and groundfish trawlers, albacore and salmon trollers, gill-netters, Hawaii tuna longliners, trappers, and mainland U.S. handline vessels. However, because almost half of the permit holders did not participate in the fishery during 1986, the active fleet, as defined earlier, consists of those vessels taking at least one trip during the year.

The active fleet in 1984-86 ranged in length from 12 to 25 m (35 to 76 ft) overall; over 50% of the vessels were in the 18 m (50-60 ft) range. A few motorsailers have been active in the fishery. In 1986, the 24 active vessels made 160 NWHI bottom fishing trips. The number of trips per vessel varied from 1 to 16 trips for individual vessels, average trip length was 15 d, and average fishing time was 6 d.

The fleet also can be categorized into three operational groups: core bottom fish vessels, multifishery vessels, and other vessels (Fig. 7). "Other vessels" are those vessels that have permits but are not active in the NWHI bottom fishery. The 20 core vessels primarily fish for bottom fish throughout the year. The Honolulu-based fleet consists of 15 vessels, and 3 are based on the neighbor islands. Two vessels are semiretired. The vessels in the core group average 17 m (52 ft) long, and only one is over 20 m (60 ft). These vessels took 82.5% of the 160 trips made in 1986 and caught 79% of the bottom fish monitored by the Honolulu Laboratory (Figs. 8, 9).

The 11 multifishery vessels are those whose primary orientation is toward other species, such as albacore, tuna, and lobster. These vessels average 20 m (60 ft) in long. They took 17.5% (28) of the trips and caught 21% of the bottom fish.

The "other" vessels with NWHI bottom fish permits are larger, averaging 24 m (74 ft) long (maximum length) 31 m (94 ft). These are primarily tuna and lobster vessels; none took recorded bottom fishing trips in 1986.

As catch rates declined for prime commercial species, such as opakapaka, search and travel time increased, and loads were mixed with lesser valued species, such as ulua and hapuupuu. Fishing trips that comprised more than one bank became commonplace. Larger vessels with the range to travel farther up the NWHI chain had an advantage over the smaller vessels, which were forced either to spend more time searching in the lower reaches of the archipelago or to increase their fuel capacity by installing additional fuel tanks or carrying 220-L (55-gal) fuel drums on deck.

Fishing effort location was obtained for 60% of the NWHI bottom fish trips recorded by the Council and Honolulu Laboratory monitoring program in 1986. There were 38 trips (40%) taken to the lower NWHI (Middle Bank to French Frigate Shoals) and 57 trips (60%) to the upper NWHI (French Frigate Shoals to Pearl and Hermes Reef).

VESSEL REVENUES

Vessel revenues for 1986 were compiled through the Council and Honolulu Laboratory market monitoring program. These revenues reflect only those trips sampled by our monitoring program. Some trips or some vessels may have been missed. Revenue from species other than bottom fish, on average, comprises 14% of sales. Nonbottom fish revenue is unimportant for most vessels but, for a few vessels, comprises more than half their revenue.

The average vessel in the NWHI sold $65,300 of bottom fish in 1986. The average trip amounted to $10,600 of bottom fish. Including the non-bottom fish species, the average vessel in the NWHI sold $76,700 in 1986 or $12,500 per trip.

In 1986, seven vessels each took less than three trips, the Council's proposed criterion for participation under its limited entry system. If we omit these vessels and omit trips shortened because of breakdowns, then the remaining vessels sold $88,100 of bottom fish per vessel in 1986 or $11,300 per trip (at a rate of 7.8 trips per vessel).

Smaller vessels can make more trips but land less per trip; therefore, it is reasonable to examine vessel revenues by class. We divided the active fleet on which we had complete information into two classes. Class I vessels landed more than $10,000 of bottom fish per trip, on average, while Class II vessels landed less. Twelve Class I vessels each landed $14,800 bottom fish per trip or $120,900 for the year. Eight Class II vessels each landed $5,400 bottom fish per trip or $35,900 for the year.

Total revenue for Class I vessels would be $16,900 per trip (8.2 trips per year), adding 14% of non-bottom fish revenues to the Class I revenues. A Class II vessel's estimated total revenue would be $6,200 per trip (6.6 trips per year).

Meyer Resources, Inc. (1987) makes projections of economic returns for the average vessel by using values of $9,800 per trip. His analysis shows the average NWHI bottom fish vessel losing $9,700 per trip after fixed costs on seven trips per year. Neither Class I nor Class II applies directly to Meyer's analysis, and we cannot adjust his cost figures to estimate costs and net returns per class of vessel. However, we can use the average bottom fishing vessel's returns and apply them to Meyer's cost formula.

The total revenue per trip of the average active bottom fishing vessel was $11,500 on 7.55 trips in 1986. Applying Meyer's seven-trip formula for costs, the average NWHI bottom fishing vessel made net operating returns (before accounting for fixed costs) of $2,700 per trip, but lost $60,000

for the year after fixed (annual) costs (e.g., capital costs, annual repairs, vessel insurance, moorage fees, and administrative costs) (Table 5).

At 1986 catch rates, catch per trip could decline by 30% with fixed crew costs ($2,356) before the zero ($0) net operating revenue level would be reached. Of course, this implies much larger total annual losses, at $80,450 per year, when including fixed costs.

Economic theory suggests that vessel owners will continue to fish as long as operating costs are covered, unless they have a better alternative. In this case, where fixed costs are not covered, on average, by net operating revenues, there is an incentive for a vessel operator to take more trips in an attempt to spread the net operating revenue over fixed costs. This suggests there is still considerable incentive for active bottom fishing vessel owners to continue in the fishery. There is also incentive for other vessels to enter the fishery as long as they can cover their fixed costs in other fisheries or as long as their net operating revenue is lower in other fisheries than, as they perceive, in the NWHI bottom fishery. These factors increase the possibility of economic overfishing in the NWHI and may lead to unfavorable biological effects if the resource is responding to the current levels of fishing effort (Ralston and Kawamoto 1987).

PROPOSED ECONOMIC RESEARCH

The biggest gap in public knowledge about the NWHI bottom fishery concerns the economic condition of the vessels in the fleet. Therefore, a research proposal has been developed between the Honolulu Laboratory and the Council concerning an economic assessment of the NWHI bottom fish fleet. This research will complement the limited entry proposal and provide more exact information on economics of vessel operation. A cost profile of the major classes of bottom fishing vessels will be developed. This cost profile will be used to test the sensitivity of economic conditions to changes in key factors, such as the price of fish and the number of days at sea. This analysis may also be able to integrate existing information on market conditions to examine interactive effects between classes of vessels.

Another priority in economic research concerns the relationship between the Honolulu Laboratory's market sampling and the entire Hawaii market. The last full wholesale market survey in Hawaii was conducted in 1979, and the last full retail market survey was conducted in 1982. Therefore, a new survey of the wholesale and retail market is an important and timely objective. The Honolulu Laboratory will make a proposal for such a survey, although fielding the survey will be contingent upon funding and Office of Management and Budget approval.

SUMMARY

The key features of this report are summarized:

1. Total revenue earned in the NWHI bottom fishery has grown by 35% over the past 3 yr, although price per pound has declined by 5%.

2. Imports from other Pacific islands are now playing an important role in the Hawaii bottom fish market (13%), but their price impact must be analyzed in terms of timing and product composition.

3. Price response to changes in the volume of market sales remains as previously described: flexible but not drastically on a weekly or monthly basis. Premiums for high quality product are substantial.

4. Composition of the bottom fish fleet has been changing rapidly, length of trip is increasing, and more research is required on fleet operations to understand its economic dynamics.

5. Insufficient information is available on fishing costs to reliably estimate the profitability of the entire fleet, or by vessel class. Evidence suggests that, on average, net revenue is being obtained on operations but fixed costs are not being covered. Incentives exist for continued fishing pressure despite an apparently bleak profit picture.

6. Economic research priorities include

   a) fleet operations analysis,

   b) vessel cost-earnings information and analysis,

   c) Hawaii market channels update, and

   d) economic research on bottom fish fisheries of American Samoa, Guam, and the Northern Mariana Islands.

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Table 1.--Hawaii bottom fish market revenue, 1986.

Source	Revenue[a] ($)	Average price ($/lb)
Northwestern Hawaiian Islands	1,900,000	2.23
Main Hawaiian Islands	2,700,000	3.24
Hawaii subtotal	4,600,000	2.72
Pacific island nations	700,000	2.38
Market total	5,300,000	2.67

[a]Revenue is scaled to a market-wide estimate based on the National Marine Fisheries Service and Western Pacific Regional Fishery Management Council monitoring program's sample of Hawaii bottom fish market sales.

Table 2.--Northwestern Hawaiian Islands bottom fish revenues and prices, 1984-86.

Year	Revenue ($)[a]	Average price ($/lb)
1984	1,400,000	2.35
1985	1,800,000	2.22
1986	1,900,000	2.23

[a]Revenue is scaled to a market-wide estimate based on the Southwest Fisheries Center Honolulu Laboratory and the Western Pacific Regional Fishery Management Council's monitoring program sample.

Table 3.--Hawaii bottom fish prices, 1986.[a]

Species	Average price ($/lb) by source			
	Market	NWHI	MHI	Pacific islands and other sources
Opakapaka	$3.41	$3.20	$3.78	$3.92
Onaga	3.93	3.13	4.39	3.37
Hapuupuu	1.61	1.56	2.23	3.16
Ulua	1.32	1.07	2.00	1.12
Ehu	2.56	2.14	3.32	2.38
Uku	2.80	2.43	2.86	1.88
Subtotal	$2.78	$2.24	$3.59	$2.78
Other	1.84	1.62	1.83	1.98
Total	$2.67	$2.23	$3.24	$2.38

[a]Data from the Southwest Fisheries Center Honolulu Laboratory market monitoring program.

Table 4.--Northwestern Hawaiian Island bottom fish fleet composition, 1986.

Vessel category	Vessels (No.)	Length (ft)	Trips (No.)	Catch[a] (lb)
Core	20	52	132	623,000
Multifishery	11	60	28	161,000
Other	14	74	0	0
Fleet	45	61	160	784,000

[a]As monitored by the Southwest Fisheries Center Honolulu Laboratory and the Western Pacific Regional Fishery Management Council.

Table 5.--Cost of operation, Northwestern Hawaiian Islands bottom fishing vessel, 1986.

Operation	Cost[a]
Annual revenue	$86,825
Operating costs	53,280
Crew share	13,200
Net on operations	$20,345
Fixed costs	80,450
Net revenue	-$60,105

[a]Cost data estimated from Meyer (1987).

List of Figures

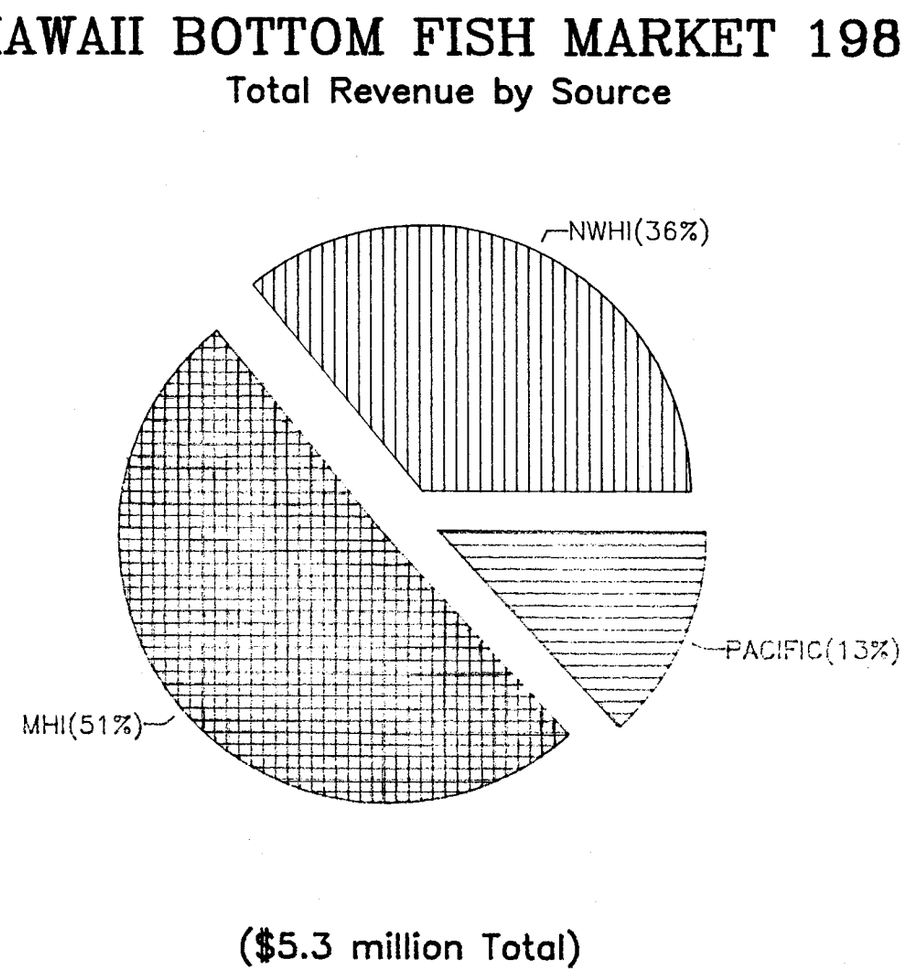


Figure 1.--Hawaii bottom fish market revenue, by source, 1986.

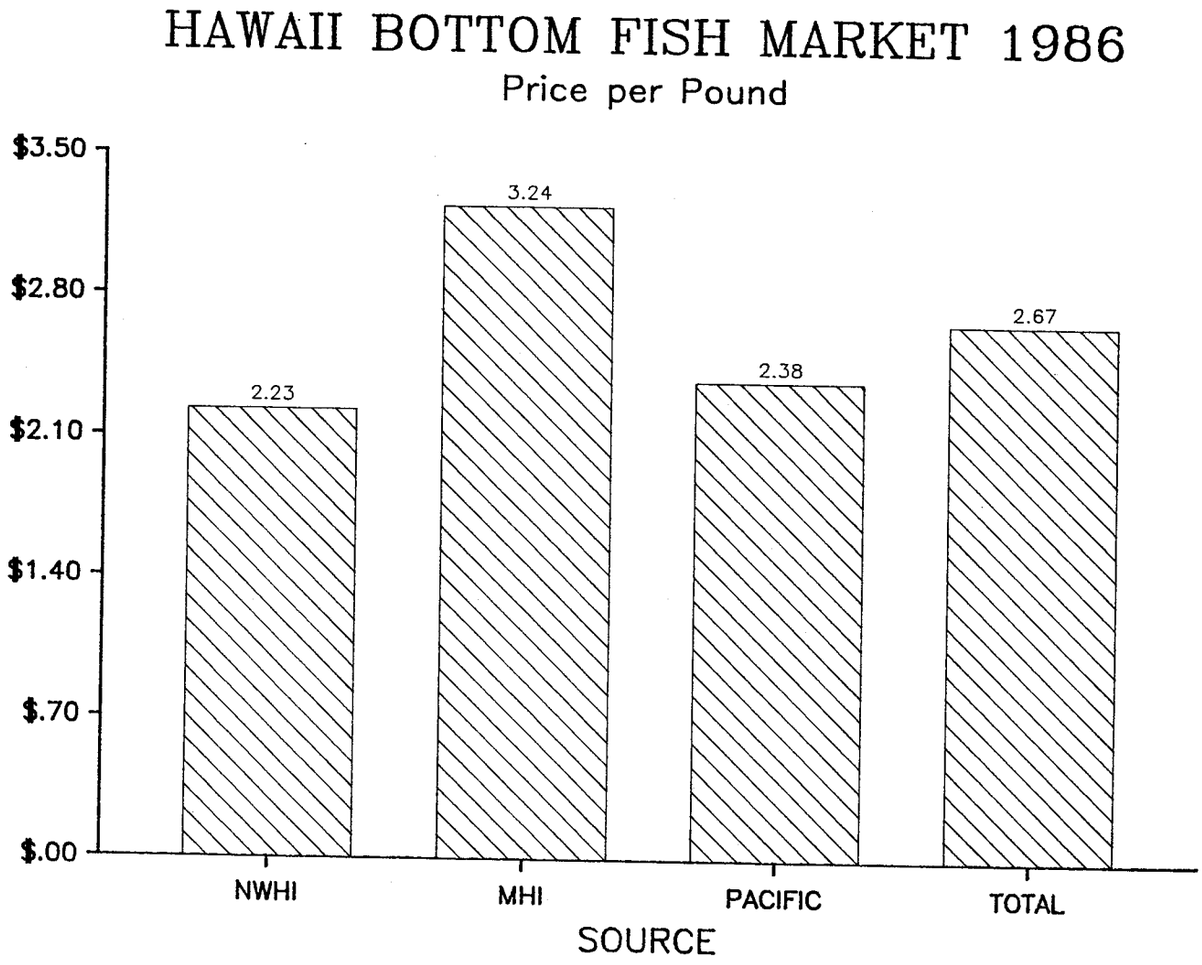


Figure 2.--Hawaii bottom fish prices, by source, 1986.

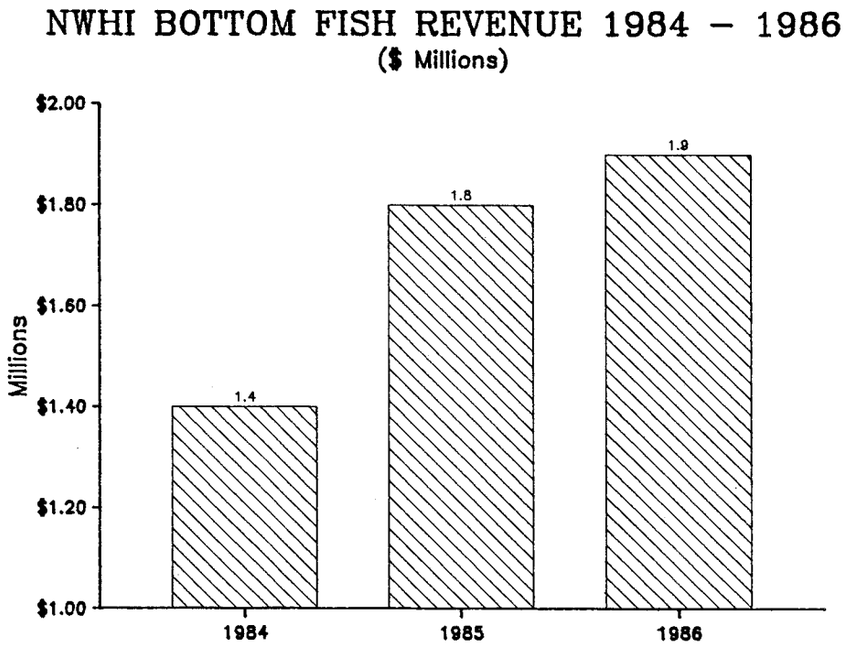
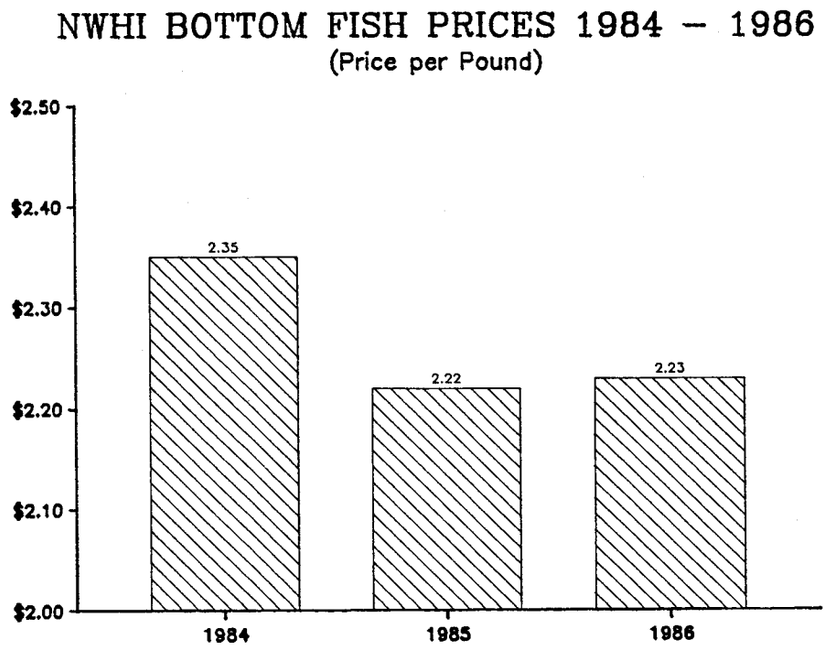


Figure 3.--Northwestern Hawaiian Island bottom fish revenue, 1984-86.



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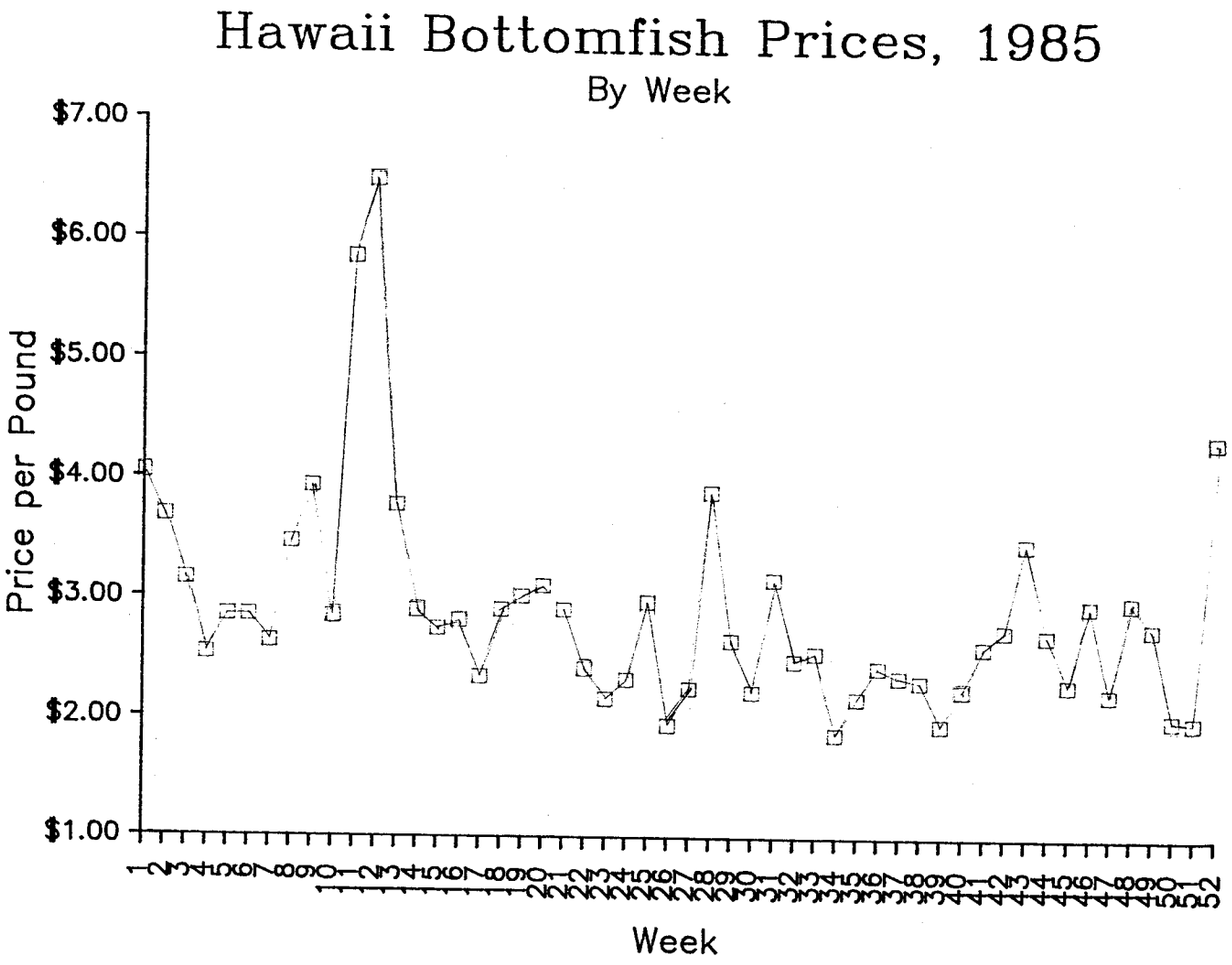

Figure 5.--Hawaii bottom fish weekly market price fluctuation, 1985.

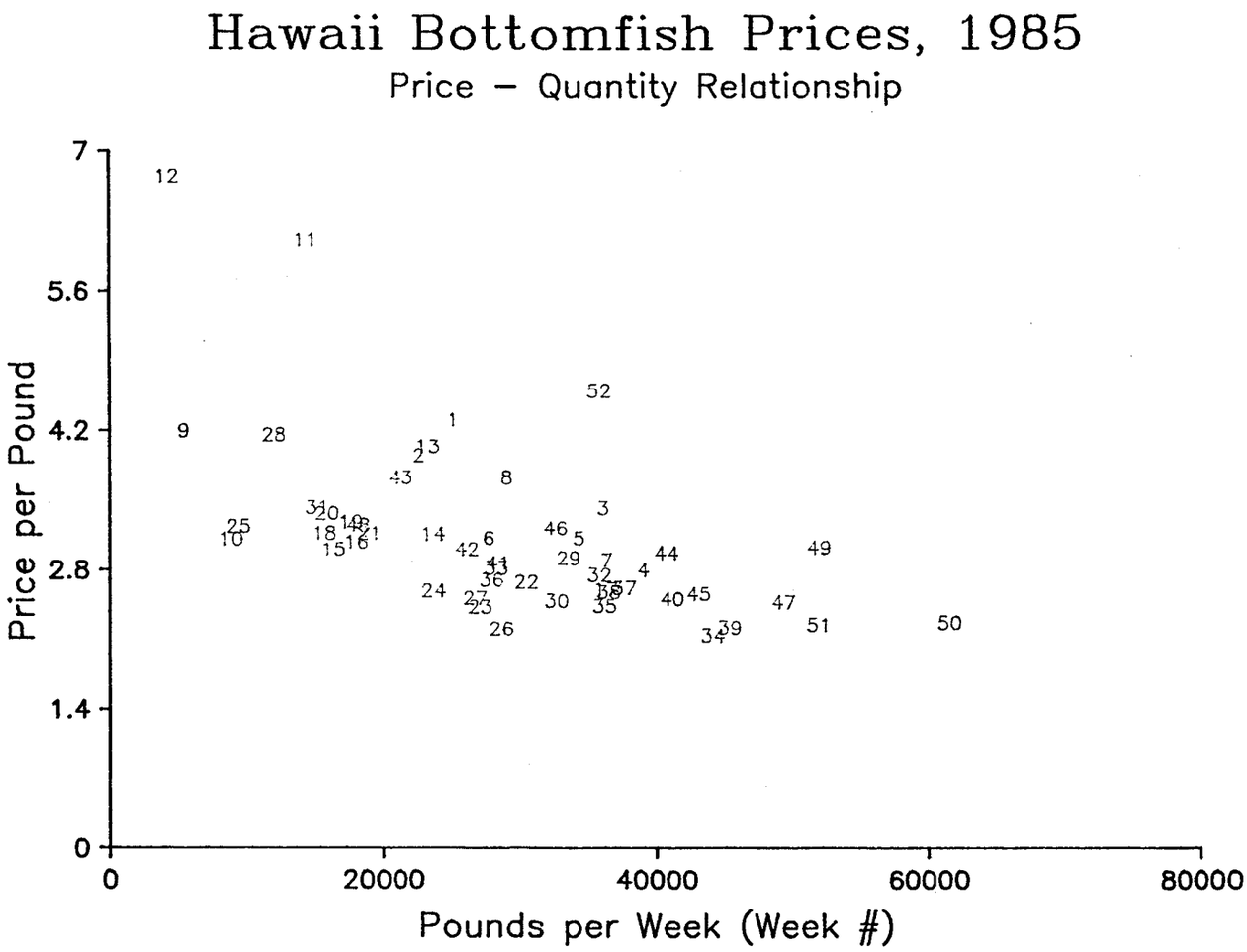

Figure 6.--Hawaii bottom fish market price-quantity relationship, 1985.

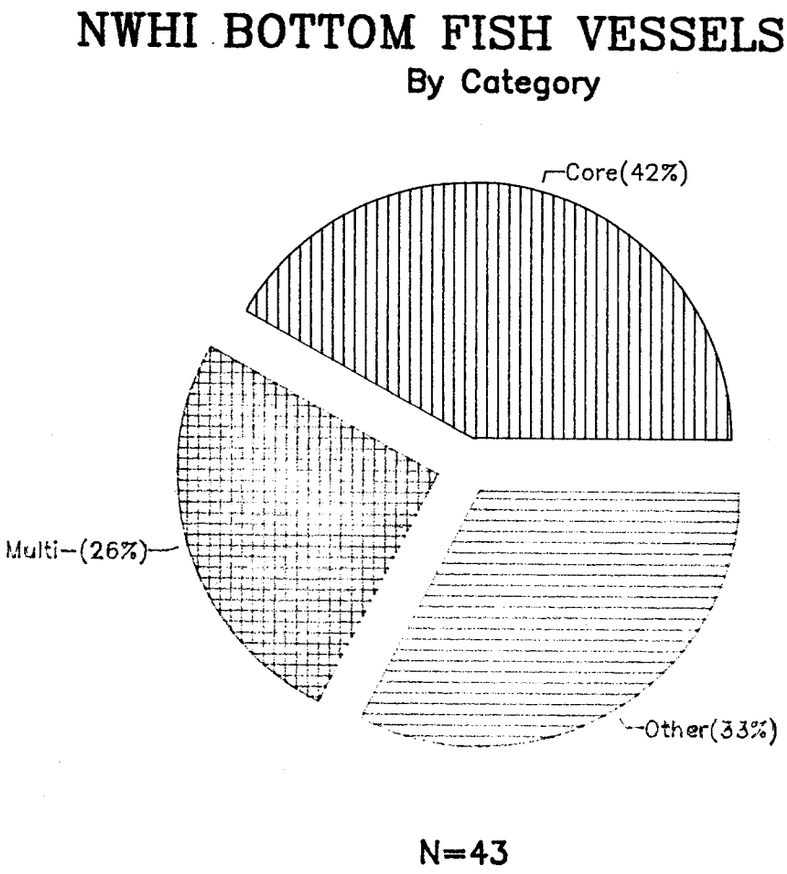

Figure 7.--Categories of Northwestern Hawaiian Island bottom fish vessels, 1986.

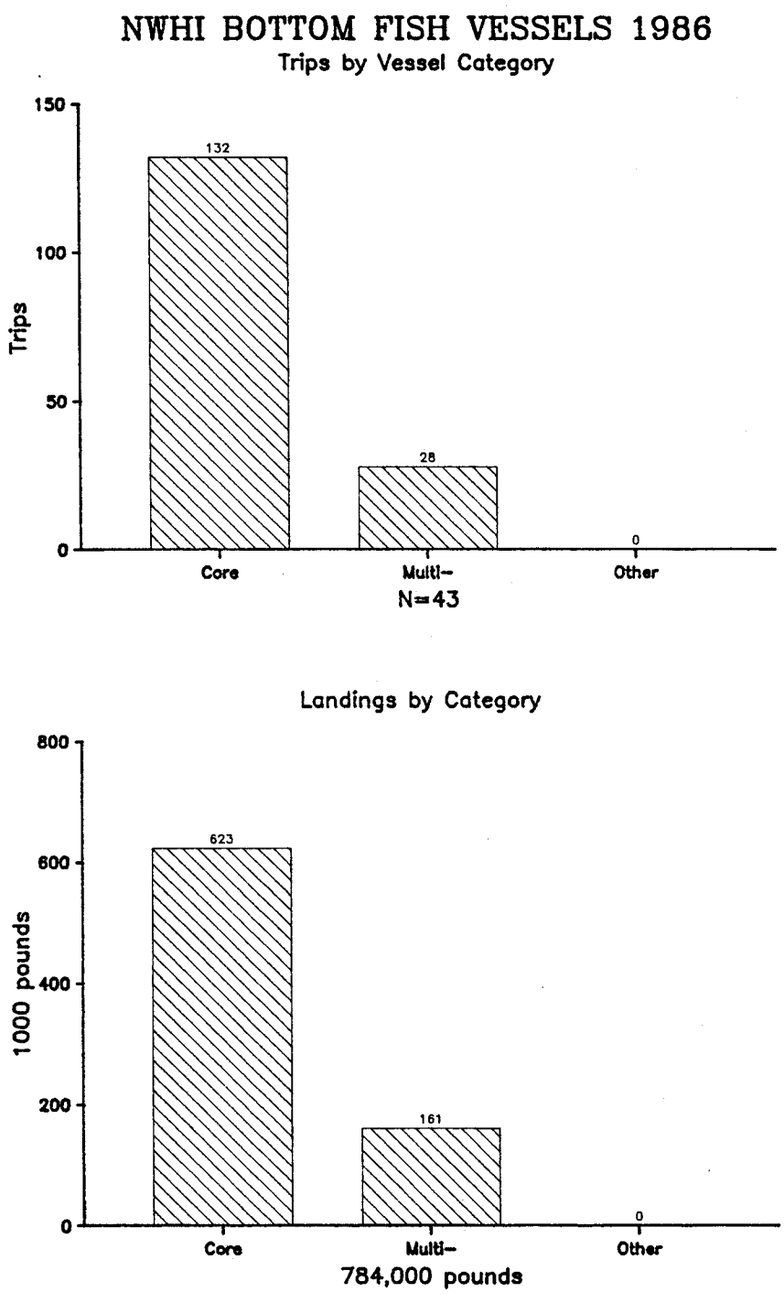

Figure 8.--Trips and landings by vessel category, 1986.

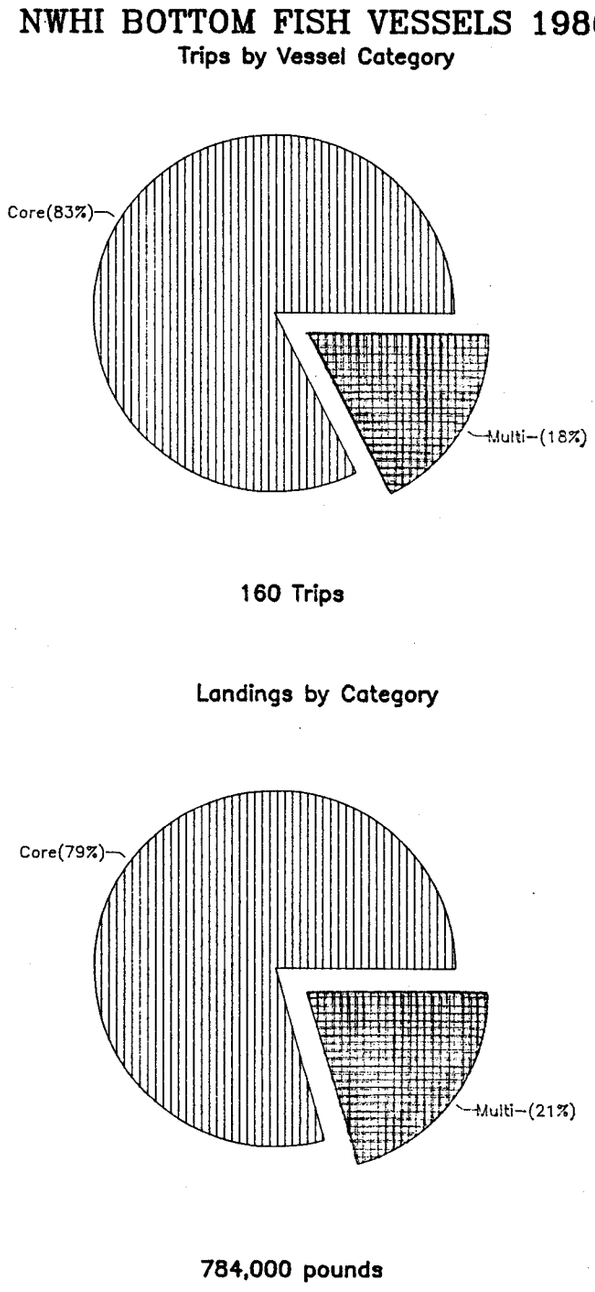

Figure 9.--Trips and landings by vessel category (percentage), 1986.